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December 18, 2002

VIA ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Comment filing, *Allocations and Service Rules for the 71-76 Ghz, 81-86 Ghz and 92-95 GHz Bands*; *Loea Communications Corporation Petition for Rulemaking*, WT Docket No 02-146, RM-10288

Dear Ms. Dortch:

Attached for filing are the initial comments of Loea Communications Corporation ("Loea") in the above-captioned dockets. Please do not hesitate to contact me with any questions or concerns regarding this filing: 202.955.9890.

Sincerely,

Stephanie A. Joyce

Counsel for Loea Communications Corporation

cc: Service List

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands	)	WT Docket No. 02-146
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	)	
Loea Communications Corporation Petition for Rulemaking	)	RM-10288
	)	

COMMENTS OF LOEA COMMUNICATIONS CORPORATION

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Dated: December 18, 2002

SUMMARY

The 71-76 GHz and 81-86 GHz bands will be an extremely valuable addition to the commercial spectrum, providing a robust medium for wireless broadband services throughout America and serving as a precedent for the use of this spectrum worldwide. These bands will enable multi-gigabit-per-second (virtual fiber) wireless communications for both the private sector and the Federal Government for the first time in the history. With its extremely low risk of co-channel interference and the availability of contiguous spectrum blocks large enough to enable multi-gigabit communications, rapid and low-cost deployment of this spectrum will greatly benefit the public.

The 71-76 GHz and 81-86 GHz bands will truly enable real "first mile" (for customers) or "last mile" (for carriers) access to advanced broadband services virtually anywhere in the United States — not just in major metropolitan areas that have access to high speed wireline services. Because the 71-76 GHz and 81-86 GHz spectrum may be utilized without the tremendous resources necessary to deploy fiber optic cable and other wired high-speed transmission facilities, its is Loea's belief that this spectrum can play an important role in ensuring that every American wishing for broadband services will be able to obtain such services quickly and at reasonable costs. To bring this and the other benefits of the 71-76 GHz and 81-86 GHz spectrum to the public, the Commission must look at the unique nature of the spectrum and the technology and tailor its licensing construct accordingly.

One aspect of the nature of the 71-76 GHz and 81-86 GHz spectrum and technology that the Commission must weigh heavily is that spectrum scarcity, and therefore the notion of mutual-exclusivity, does not apply. This is due to the "pencil beam" nature of the transmission paths at 71-76 GHz and 81-86 GHz spectrum that are particularly resilient to harmful

interference. The absence of scarcity means that many commonly used wireless regulatory elements, including exclusive wide area geographic licenses, spectrum partitioning and disaggregation, and competitive bidding, are inapplicable to the 71-76 GHz and 81-86 GHz spectrum.

This lack of scarcity also means that the Commission may grant a virtually limitless number of blanket licenses (after which the blanket licensees would be required to coordinate transmission paths with an independent third-party coordinator without further use of the Commission's resources) to use this spectrum without fear of congestion or service degradation. Although this lack of scarcity might initially appear to make the 71-76 GHz and 81-86 GHz spectrum a candidate for unlicensed operations, licensing remains necessary for this spectrum to encourage investment and ensure service quality. In addition, because the spectrum is shared with the Government on a co-primary basis, blanket licensing and coordination will allow private and Government use of the spectrum to co-exist because, at a minimum, the Government would be able to coordinate its use of the spectrum with the private sector by referring to the path database that would be created and maintained by the industry through a third-party coordinator.

Also key to the successful use of this spectrum is the adoption of technical rules that enable the most flexible, efficient, and robust use, both for existing technology and for technologies not yet developed. The Wireless Communications Association ("WCA") has already submitted its technical proposals for the UMW spectrum, and Loea fully supports those proposals. In these comments and the attached white paper by Dr. John Lovberg, Loea provides additional explication of the WCA's proposed rules, which will enable the broadest possible use of the 71-76 GHz and 81-86 GHz bands for both existing and future services.

The 71-76 GHz and 81-86 GHz bands are unique blocks of radiospectrum that do not share the same technical attributes as already licensed lower-frequency spectrum. They therefore do not warrant adoption of many of those lower-frequency spectrum rules. In keeping with the Commission's commitment to move away from a "one-size-fits-all" construct to regulations that are market-based and sensitive to consumer needs, Loea urges the Commission to adopt licensing and service rules for the 71-76 GHz and 81-86 GHz bands that make the best sense for the deployment and use of this new commercial spectrum for the benefit of the American public.

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COMMENTS OF LOEA COMMUNICATIONS CORPORATION

Loea Communications Corporation ("Loea"), by its attorneys, provides these comments in response to the Notice of Proposed Rulemaking issued in this above-captioned docket.[1] In this proceeding, Loea's primary interest, and therefore the focus of these Comments, is the rapid and efficient deployment of the 71-76 GHz and 81-86 GHz spectrum, which is collectively referred to herein as the "Upper Millimeter Wave" or "UMW" spectrum.[2] In support of these comments, the following is respectfully shown:

I. INTRODUCTION

A. About Loea

Loea, a subsidiary of Trex Enterprises Corporation ("Trex"), is devoted to developing and deploying wireless technologies. It has developed a high-speed, high-resolution data transmission solution for the UMW spectrum that is capable of bringing 1.25 gigabits-per-second ("Gbps") full duplex throughput over a highly directional, 30 milliwatt ("mW") beam. Loea

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1 *Allocation and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands; Loea Communications Corporation Petition for Rulemaking*, WT Docket No. 02-146, Notice of Proposed Rulemaking, FCC 02-180, 17 FCC 12182 (2002) ("*NPRM*").

2 The 71-76 GHz and 81-86 GHz spectrum is the subject the Loea's above-referenced Petition for Rulemaking, which was filed at the Commission on September 10, 2001 ("Loea Petition").

calls these transmissions "pencil beams" because they are only 0.36 degrees wide when deployed with two-foot antennas at each end of a link.

Loea has been the leader in this technology, and through its initial field tests, Loea was able to generate and support its petition for rulemaking to the Commission. Since it submitted its petition, Loea has begun an initiative to field test this technology, in accordance with applicable Commission experimental authorization. These experiments have provided Loea with first-hand experience of the effectiveness of this new medium of communications. More importantly, they have generated significant input from potential users and provided insight on potential applications of this technology, which Loea explains in detail this response.

Loea has thus far achieved 1.25 Gbps of throughput capacity. Loea is developing technology that will enable the equivalent of 2.488 Gbps communications within one year, and will develop the technology to provide 12.5 Gbps throughput within two years, thus taking full advantage of the proposed contiguous spectrum to meet the next "10-Gigabit Ethernet" standard for connectivity.

Loea has also developed and is applying for an STA with the Commission to demonstrate an ANSI SMPTE-292M standard for streaming uncompressed High Definition TV at 1.485 Gbps next month for the TV industry. The ability to stream uncompressed High Definition TV is an important milestone for the TV broadcasting industry in its goal to meet the deadlines of the Commission.

Loea tested its pencil beam technology in July, 2001 in Hawaii, with striking results: a 5 mW transmitter was able to transmit to a receiver 1.7 miles away, with a terminating radial footprint of only 28 feet and 240 Watts ERP in delivery.[3] A second dish operating within that

[3] A full description of the technical characteristics of the 71.0 to 76.0 GHz and 81.0 to 86.0 GHz spectrum appears in the Loea Petition at pages 3-5, and in the paper by John A.

28-foot radius was able to use the same frequency spectrum without interference, needing only a slight directional adjustment. Loea later extended its links to ten miles, demonstrating the robustness of this technology to communicate effectively over this distance.

Loea subsequently installed a link for the University of Hawaii between its Hawaii Institute of Marine Biology facility on Coconut Island and the University's Windward Community College campus (a distance of 2.4 miles). This link is a Gigabit Ethernet ("Gig-E") link operating at 1.25 Gbps full duplex. This virtual fiber link was installed in less than a day. The alternative to this link was for the University to deploy fiber at a cost in excess of $500,000, according to the Institute's Information Technology ("IT") manager. It is interesting to note that the small number of PhD staff and the students were only using approximately 1% of the link's capacity when it was first installed; yet, one month later, the same group was registering access of around 300 Mbps on most mornings. This example underscores the potential demand of the public for broadband if ubiquitous broadband were readily and economically available.

For the Federal user, Loea has deployed its technology in a link between two United States Navy facilities in Kauai in Hawaii and successfully demonstrated communications over a distance of 7.4 miles. This link demonstrates the utility of the technology for the Federal Government at a location where fiber-like speeds are required but are not available and are prohibitively expensive to install.

To test the technology in an urban environment, Loea also deployed its technology in Lower Manhattan, New York, between two buildings. The demonstration involved several links installed within different offices with the communications beam passing through two sets of windows. This installation proved the utility of narrow beams traveling through narrow gaps

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Lovberg, *Fixed Point-to-Point Operations in the 71.0-76 GHz and 81.0-86 GHz Bands*, attached as Appendix A to the Loea Petition.

between buildings (not generally possible with microwaves) and the potential for an almost infinite number of users without the likelihood of interference.

The New York test also gave Loea insight into the needs of prospective customers and potential applications for this technology. Three major possible applications became immediately apparent. The first application is alternative access. Given the recent events of September 11, 2001 ("9-11"), a report was issued by the Lower Manhattan Telecommunication Users Working Group (LMTUWG), which cited the events of 9-11 and the shortcomings of the existing telecommunications infrastructure. Three of seventeen major issues in the report had no immediate solution. The three issues were alternative access to buildings, alternative riser access within buildings and a solution to bypass Central Offices. Given that Loea's technology is virtual fiber, it is a viable solution to all three of the issues raised by the LMTUWG, assuming the Commission makes available the proposed contiguous blocks of spectrum.

The second application that became apparent to Loea and prospective users of the bands is Local Area Network Extensions. Loea demonstrated a Gig-E link between two buildings with one end of the link being connected to a simple switch comprised of a Gig-E input port and 10-100 output ports connectible to computers. In the future, this technology will connect users in different buildings, allowing them to communicate with each other using simple Internet Protocol communications. The networking will be simple and within the capacity of a company's IT manager to install and maintain such a network. Further, the cost of a connection between the buildings could be as low as a monthly payment for a fiber connection between buildings from a carrier. With such networks and unlimited broadband, users can now take advantage of video over IP and other high-bandwidth applications.

The third application is storage area networking. Most of the major financial institutions require backup of their financial information to off-site locations. This is more important today given the events of 9-11. This spectrum and its virtual fiber applications can be used as either a primary or backup link. In addition, storage area networking perhaps has the most stringent requirements for any telecommunications applications for latency and error issues, requiring less than a 2 millisecond latency. Loea's technology, using this spectrum, easily can meet these requirements; even with sophisticated forward-error correction, Adaptive Transmitter Power Control, and in-band network monitoring overhead, latency is only a few microsecond per link.

Loea's experience in New York brought to light a major concern of commercial enterprise IT managers: they require absolute assurance against interference with other links. In the case of storage area networking applications, because of the importance of the applications and very significant cost associated with implementing solutions, IT managers stated they would be loathe to deploy this spectrum without such assurances. Warranties of "minimal probability" or the like are simply not sufficient. In another case, a company advised that they would not relocate their offices and leave their servers in a remote building unless they could be assured of communications with no interference. Hence, Loea strongly urges the FCC take these requirements into account and adhere to the regulatory scheme proposed herein.

Finally, Loea's experiments through Special Temporary Authority Experimental Licenses ("STA's") granted by the Commission have confirmed that this spectrum, if the rules are adopted as proposed by Loea, will enable virtual fiber communications at 99.999% weather availability and 99.999% equipment availability up to one mile for most of the country. This is carrier-grade service. Accordingly, the Commission should allow blocks of contiguous spectrum and adopt the technical rules to enable pencil-beam transmissions over the UMW spectrum.

B. The UMW Regulatory Environment

For Loea and the other companies that have worked to develop technologies and applications in the UMW spectrum, this rulemaking is an important step in bringing the fruits of their labor to the public. Loea believes that UMW services and applications (both government and non-government) will have profound benefits for the American public's welfare.[4] These benefits will include the ability to deploy broadband wireless services rapidly and effectively anywhere and at anytime, particularly in those places where wireline broadband services do not, and may never, exist.

As Loea has explained in this and other proceedings,[5] the UMW spectrum and the unique technology it enables challenge notions of scarcity, interference, and mutual exclusivity, and the FCC needs to tailor its rules to these realities if consumers are to achieve the maximum benefit.[6] Loea's Petition for Rulemaking was based on this premise, and it garnered broad support throughout the wireless industry and the Federal Government with respect to the adoption of flexible, technologically neutral allocation and service rules for the Upper Millimeter Wave

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4 One of the Chairman Powell's four tenets of spectrum policy reform is maximizing consumer choice, principally by speeding innovative services to market, while remaining mindful of public safety and defense requirements. *See* Remarks of Chairman Michael K. Powell at the Silicon Flatirons Telecommunications Program, University of Colorado at Boulder, "Broadband Migration III: New Directions in Wireless Policy" (Oct. 30, 2002) ("Powell Remarks") ("Such a policy must embody what we have seen benefit the public in every other area of consumer goods and services – choice through competition, and limited, but necessary, government intervention into the marketplace to protect such interests as access to people with disabilities, public health, safety and welfare.").

5 Loea Petition at 8-9; Comments of Loea Corporation, ET Docket No. 02-135, at 2-4 (filed July 8, 2002); Reply Comments of Loea Corporation, ET Docket No. 02-135, at 2 (filed July 23, 2002).

6 *See* Powell Remarks, note 4, *supra*.

spectrum.[7] Indeed, several commenters have noted that UMW spectrum is a viable solution to the scarcity and congestion endemic to landline broadband technology.[8]

To realize this result, it is incumbent upon the Commission to establish a regulatory environment that comports with Congress's goals of encouraging "the most efficient use" of spectrum in order to spur "rapid deployment" of innovative wireless services.[9] This task will require the Commission to evaluate and resolve significant economic, technological and licensing issues that are crucial to ensuring delivery of UMW services to the public. To this end, Loea urges the Commission to create a hybrid regulatory construct encompassing conventional regulation, where appropriate, while allowing the industry to assume the responsibility of ensuring that the UMW spectrum is deployed on a non-interference basis.[10] In many instances, this effort will entail what Nancy Victory, Assistant Secretary of Commerce and Director of NTIA, characterized as "eliminat[ing] legacy regulations that stand in the way of innovation."[11]

Specifically, the Commission should adopt a regulatory framework composed of two critical components. The first component is a set technical rules to ensure that "pencil beam"

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7 *See generally* Docket WT 02-146, Comments of the Personal Communications Industry Association ("PCIA Comments"); Comments of the Fixed Wireless Communications Coalition ("FWCA Comments"); Comments of Pacific LightNet ("Pacific LightNet Comments"); Comments of the Boeing Company ("Boeing Comments"); Comments of DMX Stratex Networks ("DMX Comments"); Comments of Telaxis Communications ("Telaxis Comments").

8 *See* Telaxis Comments at 2; Endwave Comments at 2; DMC Stratex Comments at 4-5; Boeing Comments at 5; Pacific Lightnet Comments at 2.

9 *Omnibus Budget Reconciliation Act*, H.R. Rep. No. 103-111, 103rd Congress, 1st Sess. at 576, 573 (1993) ("*House Report*").

10 Recently Chairman Powell noted that "[t]here is no one-size-fits-all model for spectrum policy." *See* Powell Remarks, *supra* n.4.

11 Remarks by Assistant Secretary Nancy J. Victory, Global Forum 2002 (Oct. 17, 2002).

technology is utilized in a means capable of delivering transmissions at multi-gigabit speed.[12] The second necessary component is a licensing regime that enables efficient spectrum access, rapid path deployment, minimum entry costs, and assurance of minimal interference.

More specifically in regard to the licensing rules, the Commission should hold that any provider qualified to be a Commission licensee will be granted a blanket authorization allowing it to construct and operate UMW spectrum paths anywhere in the United States during the term of the licensee. To avoid any potential for harmful interference, which is demonstrably minimal as several commenters have shown, the industry will create and operate a path coordination process that is independent from the Commission. Successful coordination would be a prerequisite to constructing and operating UMW paths under the blanket license.[13]

Under Loea's proposal, the Commission's licensing resources would only be utilized in the initial approval of the licensee as required under Section 307 of the Act.[14] The path coordination process, including the storage of all path information, would be maintained by the industry outside of the Commission's databases and without Commission resources. The process would be somewhat similar to traditional point-to-point microwave licensing, but the Commission would be relieved of all of the burdens of path-by-path licensing.[15]

Loea's licensing approach comports with the unique characteristics of these bands and the services they support — namely, the absence of spectrum scarcity and low costs of access

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12 Loea's proposed technical rules appear in Section V.B, *infra*, and are fully explicated in the attached paper by John Lovberg, Ph.D., *Specific Proposals for Technical Rules Governing the 71-76, 81-86, and 92-95 GHz Bands* ("Lovberg Paper").

13 The licensee would also be required to comply with other applicative regulation, *e. g.* submission of environmental assessments, international coordination; quiet zone restrictions; and special coordination regarding certain government installations.

14 47 U.S.C. § 307(a).

15 Loea discusses how the FCC's process operates with the Federal government's coordination process in Section III.B, *infra*.

and market entry. This approach to spectrum usage is a variation of the exclusive rights model set forth in the *Spectrum Task Force Report* released in November of this year.[16] According to the *Report*, an "exclusive use" model would provide "comparable benefits" to a commons model in circumstances like those found here — low spectrum scarcity and transaction costs.[17] Most importantly, the exclusive use approach would obviate the unnecessary and possibly significant costs of guaranteeing absolutely against harmful interference, because the use of each path is subject to "clearly defined and effectively enforced" rules.[18]

In Loea's proposal, exclusive rights are issued for each path with specific technical parameters to ensure pencil beams are employed and to protect against harmful interference. Within each path (which can be envisioned as a narrow pipe), the provider has complete flexibility of use, regardless of service or application. These exclusive rights are awarded through a blanket license on the condition that the licensee submit to third-party path coordination. Under this construct, and because UMW spectrum carries virtually no risk of scarcity, this nationwide license scheme is more appropriate than the traditional mutual exclusivity/competitive bidding approach.

In making this proposal, Loea wishes to allay any concerns that grant of nationwide licenses will limit UMW spectrum usage now or in the future. As is more fully described in the Lovberg Paper, the adoption of flexible technical and service rules will enable a broad array of providers to use this spectrum.[19] These rules strive to be as technologically neutral as possible, without losing the utility of UMW spectrum, in order that technologies not yet developed may

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16 ET Docket No. 02-135, Spectrum Policy Task Force Report at 37, 38-39 (Nov. 2002) ("*Spectrum Task Force Report*").

17 *Spectrum Policy Report* at 38.

18 *Id.*

19 *See generally* Lovberg Paper, Section 1, entitled "Hardware Operating Standards." Loea's proposed technical rules are discussed in Section V.B, *infra*.

utilize these bands effectively. As such, grant of coordinated nationwide licenses governed by Loea's proposed technical rules will result in maximum use of UMW spectrum by each licensee.

II. THE COMMISSION SHOULD ADOPT ITS PROPOSED ALLOCATIONS FOR THE 71-76 GHZ AND 81-86 GHZ BANDS

Loea supports the Commission's proposal to adopt the recommendations of WRC-2000 to modify the current allocations for the 71-76 GHz and 81-86 GHz bands in a manner that permits maximum commercial use of this spectrum.[20] In addition, rather than formal adoption of footnote 5.561, Loea suggests the establishment of technical standards for the 74-76 GHz band to protect existing Federal operations.[21] These actions will further the Commission's efforts to minimize regulation while safeguarding the government's use of spectrum.

A. The Commission Should Adopt Its Proposed Revisions Related To FSS And MSS Services

1. 71-76 GHz Band

The Commission proposes to consolidate fixed and mobile satellite services downlinks in the 71-76 GHz band.[22] This consolidation, which implements the findings of WRC-2000, will remove the possibility of uplink-downlink interference, and will simplify coordination between satellite and terrestrial services. Loea supports this approach as a sensible method for further clarifying the Commission's frequency allocations.

The Commission also proposes to demote AMSAT operations in the 75.5-76 GHz band to secondary status.[23] According to Nicholas Leggett, N3NL amateur radio operator, only five

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20 *NPRM* at ¶ 20.

21 *Id.* at ¶ 21.

22 *Id.* at ¶ 20.

23 *Id.* at ¶ 23.

amateur entities are using the spectrum at 75 GHz.[24] Granting secondary status to these few operators will not materially impede their use. In addition, providing ample alternative spectrum for future amateur use, the Commission allocated the 77.5-78 GHz band four years ago.[25]

2. 81-86 GHz Band

Were it to consolidate fixed and mobile satellite services downlinks in the 71-76 GHz band, the Commission would then allocate the 81-84 GHz band for uplinks.[26] Loea supports this approach because it will simplify coordination among users. In addition, it will ensure that satellite downlinks will not interfere with RAS services, which the Commission proposes to allocate to this band on a primary basis.[27]

B. Deletion Of RAS From The 72.77-72.91 GHz Band Is Necessary To Prevent Interference With Newly-Allocated Satellite Downlinks

The Commission proposes the deletion of RAS from the 72.77-72.91 GHz spectrum, but to grant it primary status in the 81-86 GHz band.[28] Loea finds this allocation an appropriate solution to minimizing interference with satellite downlinks in the 72.77-72.91 GHz band while ensuring adequate spectrum for RAS services. It agrees with the Commission that the allocation of the 81-86 GHz band to RAS on a primary basis "satisfies the requirement" for this service, underscored by the fact that WRC-2000 has itself adopted this deletion.[29]

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24 Comments of Nicholas E. Leggett, WT Docket No. 02-146, Appendix A (Sept. 6, 2002).

25 *NPRM* at ¶ 18 n.43.

26 *Id.* at ¶ 30.

27 *See* Section II.B, *infra*.

28 *NPRM* at ¶¶ 20, 30.

29 *Id.* at ¶¶ 17, 28.

C. The Commission Should Establish Technical Rules For Services In The 74-76 GHz To Protect Satellite Operations In Lieu Of The Adopting Footnote 5.561

Although the NTIA has requested that the Commission adopt footnote 5.561 to govern interference with Federal BSS and FSS operations in the 74-76 GHz band,[30] Loea believes that adoption of technical standards, specifically power-flux density limits, will provide adequate protection to satellite operations without the need to adopt footnote 5.561. Specifically, Loea proposes the adoption of power-flux density (PFD) limits of –138 dBW/m^2/MHz at 0° to 5° declination and –138 dBW/m^2/MHz at 5° to 25° declination at the earth surface, with no limits specified in this rulemaking for declination angles over 25°. In addition, the Commission should limit the angular elevation of fixed terrestrial services to a range of -25° to +25° from the horizon.[31] These rules will preserve sightlines at lower inclinations that are most likely to be used by terrestrial services in this spectrum. By maintaining regulatory parity with terrestrial services as well as service integrity, satellite operations are protected without a formal footnote.

D. The Commission Should Give Co-Primary Status to Federal Operations in the 75.5-76 GHz Band

Although the Commission did not seek comment on this issue, Loea requests that the Commission grant co-primary status to Federal operations in the 75.5-76 GHz band. This spectrum is presently allocated exclusively for non-governmental use.[32] Amending this allocation for Federal co-primary use will give the government use of the entire 71-76 GHz band,

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30 *NPRM* at ¶ 21.

31 The Over 40 GHz Committee of the Wireless Communications Association International has unanimously proposed these technical rules for the 74-76 GHz band. Comments of The Wireless Communications Association International, Inc. at 5-6 (filed Nov. 1, 2002) ("WCA Comments").

32 *NPRM* at ¶ 14.

under the full protections afforded primary users.[33] Loea believes that this allocation will ensure that the entire band is authorized for dual commercial/government operations, providing uniformity and maximum opportunity for entities that wish to provide services to government and non-government users. In addition, it will make available to government users the benefits of this spectrum already realized by the private sector, such as inexpensive communications links through volume sales and advances in technology.

III. THE COMMISSION SHOULD ADOPT BAND PLANS THAT ALLOCATE THE FULL 71-76 GHZ AND 81-86 GHZ BANDS FOR FIXED USE

A. UMW Transmissions Will Require the Full Block of Spectrum In Order to Provide Reliable Broadband Services

The Commission seeks comment on Loea's proposal that the full 71-76 GHz and 81-86 GHz blocks be allocated for fixed use.[34] The record to date overwhelmingly supports adoption of this plan because allocation of full 5 GHz blocks will ensure the maximum throughput for dense data transmissions, making this spectrum a true substitute for wireline broadband solutions.[35] In addition, several commenters support this concept as being the most efficient and competitive allocation methodology.[36]

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33 According to Dr. Lovberg, the present omission of co-primary federal authorization for this spectrum "presents a complication for hardware suppliers developing 'dual use' technology suitable for commercial users as well as Government and Military users." Lovberg Paper at 17.

34 *NPRM* at ¶¶ 59-60.

35 Boeing Comments at 5 (segmentation the bands "would deny potential licensees the ability to realize the fiber-like data transmission rates that are possible in these bands."); Pacific LightNet ("If the FCC adopts Loea's [band plan] proposal, Loea and other companies will be able to provide gigabit-per-second broadband access using a wireless technology.").

36 WCA Reply Comments at 3; Pacific LightNet at 1; Boeing Comments at 4-5; Endwave Comments at 3-4; PCIA Comments at 2-3; DMC Stratex Networks Comments at 2-3; Fixed Wireless Communications Coalition Comments at 2-3.

It is wholly unsurprising that UMW technology is unique when compared to lower-band technology. Using a flat-panel antenna that is no more than 15 inches square, this technology is able to initiate multiple "pencil beam" signals that are able to carry high-speed broadband transmissions over many miles. This is without question a significant and innovative breakthrough for the use of spectrum in the 70 GHz and 80 GHz range.

The promise of this unique technology will not, however, be realized if providers are unable to obtain the entire use of the UMW band spectrum blocks. As Boeing explains, "[t]ransmission rates as high as 10 Gbps may be possible, but only if the entire bandwidths are made available to any licensee."[37] Loea strongly agrees with Boeing that wireless broadband applications in the UMW will not be possible unless the entire bandwidth contemplated in the *NPRM* for the 70 GHz and 80 GHz spectrum is able to be utilized by the provider.

Loea emphasizes that allocating the entire UMW bandwidth for fixed path operations will not limit the ability to utilize this spectrum. First, even though the entire bandwidth would be utilized, the pencil beam nature of the spectrum means that for harmful interference to occur, two non-cooperative transmission paths would have to be virtually coincident and pointing in nearly the same direction.[38] Second, if a provider has an application that does not require the entire bandwidth, its partial use of the bandwidth would not have any impact on the use of the spectrum by other users.

B. Protection Of Government Services And Adjacent Bands

The Commission seeks comment on whether special rules should be adopted to ensure the protection of government operations and of adjacent bands.[39] Loea believes that the

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37 Boeing Comments at 4-5.

38 Limited realignment of the antennas would resolve any potential for harmful interference.

39 *NPRM* at ¶ 60.

licensing framework for non-government use should take into account, and limit the potential for, harmful interference to co-primary government uses of the UMW spectrum. Two simple mechanisms could be easily implemented that would resolve sharing and protection issues related to the use of UMW spectrum by government and non-government users.

The first mechanism is the manner in which the use of the spectrum is authorized. Loea proposes that, in addition to blanket licensing, the UMW transmission paths should be coordinated by an independent third party who would maintain a coordination database. The government, through NTIA, would be provided with secure access to this database to coordinate government uses of the UMW spectrum with non-government paths. In addition, to the extent the government wished to further utilize the UMW coordination database, for instance, to register its paths, the industry would work with the government to establish appropriate security for this use. It is Loea's understanding that the Government would prefer that the UMW path information be collected and available to it as part of the process for shared use of this spectrum.

The second mechanism would be the adoption of the technical parameters proposed by Loea and WCA. As explained above, the narrow transmission beams characteristic of the 71-76 GHz and 81-86 GHz spectrum carry a very low risk of interference, because they propagate much differently than lower-frequency spectrum.[40] In the event of the potential for harmful interference, the narrow paths of the transmissions must be differentiated by only a few degrees.[41]

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40 *See* Endwave Comments at 3-4.

41 *See* Loea Petition at 12; Boeing Comments at 4.

IV. THE COMMISSION SHOULD REQUIRE FORMAL AUTHORIZATION OF ALL USERS OF THE 71-76 GHZ AND 81-86 GHZ BANDS

A. Unlicensed Use Is Not Appropriate

The Commission seeks comment on whether to permit unlicensed use of the spectrum at 71-76 GHz and 81-86 GHz.[42] During the initial phase of implementation of services in the 71-76 GHz and 81-86 GHz bands, Loea opposes a regulatory framework that would include unlicensed operations. Specifically, Loea believes that there are economic, service quality, and government/non-government sharing considerations that require a more formal, but not burdensome, licensing framework for this UMW spectrum.

1. Service Quality Considerations and Costs

After having developed the technology, spent endless hours advocating for a reasonable regulatory environment, obtaining funding, and built network infrastructure, the UMW providers will still have to sell their products and services to end users. Loea has already spoken to many potential users, including those in the public safety community and those providing live entertainment, and these entities have clearly stated they require service quality — that is, non-interference guarantees — comparable to wired technologies. This requirement could be easily achieved in a licensed environment and with minimal cost. However, in an unlicensed environment, Loea would have to meet these demands by installing additional facilities, which significantly increases the cost of deployment. In effect, by opting for an unlicensed approach, the Commission would be imposing a "competition tax", which would hobble this technology vis-à-vis its well-established wireline competition. In the end, it would slow the overall deployment of this technology. This is especially troubling when one considers that the "blanket" licensing alternative is so straightforward and so easily achieved.

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42 *NPRM* at ¶¶ 62-63.

2. *Economic Considerations*

An economic concern that the Commission must not dismiss is the ability of providers to raise the necessary capital to build networks and implement services. In the wireless arena, one of the most significant elements of an investor's due diligence is an evaluation of the provider's right to use the spectrum on a priority basis. In others words, the provider must demonstrate to the investors that it has obtained the necessary governmental authorizations to conduct services without harmful interference.

Although this attitude may change in the future, it is absolutely imperative today that providers be able to demonstrate their right to use the UMW spectrum on a non-interference basis through some form of Commission-issued or sanctioned authorization or path priority right. The fact that harmful interference is a remote possibility provides no confidence to the investor that the UMW provider can deliver *quality* services. Loea strongly believes that designating the 71-76 GHz and 81-86 GHz bands for unlicensed use will make adequate funding for these networks nearly unobtainable.[43]

3. *Interference And Coordination Considerations*

Loea believes that harmful interference will not be a major factor in the UMW services. Simply put, the different operations using this spectrum would have to be virtually on top of each other to even raise the possibility of harmful interference. Moreover, the proposed industry sponsored and operated coordination process, if adopted, will identify the potential for harmful

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[43] With venture and angel financing at a standstill, young entrants must incur a more expensive cost of capital through debt financing, and as a result must be vigilant in achieving a positive rate of return for every dollar spent. *See* Beth Healy, *Tracking the Incredible Shrinking Venture Funds in the Toughest Climate in 30 Years*, The Boston Globe, at C1 (July 29, 2002); Mark Boslet, *VC Economics: When Money Gets in the Way of Making Money*, D.J. Newswires (Aug. 2, 2002); National Venture Capital Association, *Venture Capital Commitments "Rightsizing"* (Aug. 5, 2002), available at <www.nvca.com>.

interference and allow for the modification of path proposals to avoid interference, which, in a majority of cases, will entail nothing more than a realignment of the transmission beams.

With that said, Loea is cognizant of the fact that the government, a co-primary user the UMW spectrum, is not obligated to participate in the UMW coordination database or process. Loea is also cognizant that the government's use of the UMW spectrum could have significant homeland security and defense applications. It is therefore imperative and in the public interest that, at a minimum, the government has the ability to quickly discern through access of a path coordination database where UMW paths are operating in order to avoid a harmful impact on their operations. Indeed, one of the Commission's primary goals in this spectrum reallocation proceeding was to minimize interference with federal operations.[44]

In addition to co-primary government use concerns, the Commission should take into account that the technology developed and ready for deployment in the UMW bands was not engineered to operate in an unlicensed environment. Even though UMW is robust when it comes to harmful interference, no provider could be expected to operate transmission paths of 10 miles or more without some *order* in the manner in which the paths are deployed. Assuming that workarounds could be developed, if UMW providers were to have to contend with unlicensed operations for themselves or from others operating in the UMW band, the added development and equipment cost would unnecessarily divert funds away from deployment of services and increase time cost of the services for the consumer.

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[44] *NRPM* at ¶ 20 (consolidating the 71-76 GHz band for FSS and MSS downlinks), ¶ 21 (proposing adoption of footnote 5.561 for the 74-6 GHz band), ¶ 30 (consolidating the 81-86 GHz band for FSS and MSS uplinks), ¶ 31 (proposing revision of footnote US342 to require protection of RAS by "all practicable steps").

B. Licensing Rules For The 71-76 GHz And 81-86 GHz Bands

In its Introduction to these comments, Loea stated that the Commission would be called upon to consider economic, technology and licensing issues in this proceeding. As reflected in the preceding sections of these comments, these economic, technology, and licensing issues will either drive or derail the implementation of UMW broadband services. Taking into account these considerations, Loea identifies in the following sections what it believes would be the optimal licensing regime for the 71-76 GHz and 81-86 GHz bands.

1. The Commission Should Grant Blanket Authorizations And Utilize Third-Party Coordination

Loea's proposal for licensing the 71-76 GHz and 81-86 GHz bands is simple and requires a minimum burden on the Commission.[45] Specifically, each provider wishing to provide UMW services or each user wishing to implement UMW applications for its own internal uses would file a single application with the Commission for blanket UMW authority. Once the Commission has passed on the applicant's qualifications and granted the license, the licensee must obtain authorization from an independent coordinator in order to construct and operate transmission paths anywhere in the United States. The coordinator would provide authorization for an individual path where it has determined that there is no potential for harmful interference to a previously coordinated path. In this scheme, the initial license would be recorded in the Universal Licensing System ("ULS") and all path coordination information would be held by the coordinator(s), subject to Commission and public view. As WCA has noted, this approach is not

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[45] Loea also supports the other site based licensing approaches presented by the WCA in its comments.

wholly new: the Commission uses this approach for authorization of train monitoring systems in the 900 MHz band.[46]

The Commission seeks comment on whether to apply the general geographic licensing model to the 71-76 GHz and 81-86 GHz spectrum bands.[47] As Loea and several other parties have explained, geographic licenses are appropriate for lower-frequency spectrum that carries a higher risk of interference due to the wide propagation patterns of transmissions. The UMW spectrum behaves much differently, causing interference only where two transmissions are virtually coincident, rendering geographic licensing an unnecessary and artificial restraint on the number of eligible licensees,[48] which is inconsistent with Section 309's mandate for broad dissemination of licenses.[49]

Under Loea's proposal, the coordinator will act as a clearinghouse and repository of site path information and will manage the "industry database" that several parties have proposed.[50] The coordinator will also have initial responsibility for mediating the few path disputes that may arise. The coordination will be performed in an automated fashion, allowing providers or users to obtain immediate path approval.

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46 WCA Comments at 20 & n. 49 (citing *Petition of Association of American Railroads (AAR) for Modification of Licenses For Use in Advanced Train Control Systems and Positive Train Control Systems*, Order, 16 FCC Rcd. 3078 (2001)).

47 *NPRM* at ¶¶ 66-67.

48 Loea Petition at 14-15; PCIA Comments at 2-3 (geographic licensing "would yield tremendous inefficiencies"); FWCC Comments at 2; Boeing Comments at 7.

49 47 U.S.C. § 309(j)(3). In keeping with this mandate, the Commission has stated that "opening the [wireless communications system] market to a wide range of applicants will permit and encourage entrepreneurial efforts to develop new technologies and services." *Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service ("WCS")*, GN Docket No. 96-228, Report and Order, 12 FCC Rcd. 10785, 10829 (1997) ("*Part 27 Order*").

50 PCIA Comments at 4. *See also* DMC Stratex Comments at 3; Loea Petition at 19.

The attached Lovberg Paper outlines the criteria by which path coordination should be established.[51] Coordination primarily will require precise determination of the endpoints of the transmission path, which a GPS system using a Wide Area Augmentation System ("WAAS") will provide.[52] The coordinator must also determine the path's height above ground level ("height AGL"), requiring use of accurate three-dimensional maps of the proposed site areas.[53] The choice of measuring equipment and information is best left to the coordinator, rather than the FCC, and the costs of that equipment will be recouped through a fee assessed on licensees by the coordinator.[54]

This framework of coordinated use of blanket authorizations will resolve several concerns facing UMW providers. First, it allows the providers the ability to offer service quality guarantees without incurring unnecessary costs, because once a path is coordinated, it will be free from harmful interference from any new path deployment. This ability to offer service level guarantees will be an important factor in competing in the broadband services market.

Second, blanket licenses dramatically decrease entry costs. If not required to participate in an auction, with all the fundraising and applications attendant thereto, a provider could enter the market at any time, and moreover will have the time to develop technologies and applications, obtain funding, market test and perform other tasks necessary to bring services to the public. As a direct result, innovation and new services will always be a part of the UMW market.

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51 *See* Lovberg Paper at 18.

52 *Id.*

53 *Id.*

54 *Id.*

Finally, the blanket licensing process allows the Commission to perform its statutory licensing obligations without creating artificial mutual exclusivity.[55] As a result, the licensing burden on the Commission will be minimal and significantly less than conducting an auction or implementing some other scheme to license the spectrum. The coordination of the paths will be sponsored and paid for by the UMW industry, without drawing on any Commission resources. The result will be in less expensive services for the public, because the coordination process will not in and of itself be a commercial enterprise that is driven by a profits requirement. The UMW industry would much prefer to invest its resources in technologies, applications, and services and thereby add to the economy — not through overly enthusiastic auction payments for limitless resource or payment to a middleman — but through the creation of jobs, the repayment of funding, the consumption of products and services, and the provision of services to the public and the generation of revenues.

2. *The Commission Should Adopt the Broadest License Eligibility Permitted by the Communications Act*

a. The Commission Should Permit Foreign Ownership of Licensees in Accordance with Section 310 of the Communications Act

The Commission proposes to limit foreign ownership of licenses in the 71-76 GHz and 81-86 GHz bands only to the extent required by Section 310 of the Communications Act.[56] Specifically, non-common carrier services would be subject to Section 310(a) foreign ownership limitations, while common carriers would have to comply with the more stringent requirements

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55 Section 309(j) preserves the Commission's obligation "to use engineering solutions, negotiation, threshold qualifications, service regulations, and other means in order to avoid mutual exclusivity in application and licensing proceedings." 47 U.S.C. § 309(j)(6)(E).

56 *NPRM* at ¶ 74.

of Section 310(b). This bifurcated treatment comports exactly with the plain language of the statute, which accords more scrutiny to common carrier ownership.[57]

Permitting such broad foreign eligibility is in the public interest because it will enable licensees to obtain funding from the greatest number of parties, which, as the Commission understands, is increasingly crucial in the current financial climate. In fact, the current dearth of capital investment in the wireless industry has prompted the Commission to delay Auction 46[58] and to take the historic step of permitting several participants in Auction 35 (the NextWave re-auction) to revoke their bids.[59] The Commission explained that this action was necessary with respect to Auction 35, because "[s]ince the Commission issued its *Partial Refund Order* several months ago, the state of the capital markets for entities, including the applicants, engaged in the provision of wireless telecommunications services ... has continued to decline rapidly."[60] This climate applies equally across the entire wireless industry. The Commission should therefore establish licensee eligibility rules that do not artificially limit access to capital while upholding the restrictions of the Act. Adherence to Section 310's foreign ownership limits strikes the correct balance between these concerns.

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57 Section 310(a) states simply that a "station license granted under this Act shall not be granted to or held by any foreign government," 47 U.S.C. § 310(a), while Section 310(b) requires specific inquiry into the corporate status and structure of any "broadcast [entity] or common carrier or aeronautical en route or aeronautical fixed radio station." 47 U.S.C. § 310(b).

58 DA 02-2396, "1670-1675 MHz Band Auction (Auction 46) Postponed Until April 30, 2002" (rel. Sept. 25, 2002).

59 *In the Matter of Disposition of Down Payment and Pending Applications By Certain Winning Bidders in Auction No. 35 Requests for Refunds of Down Payments Made In Auction No. 35*, WT Docket No. 02-276, Order and Order on Reconsideration, FCC 02-311 (rel. Nov. 14, 2002).

60 Public Notice, *Commission Seeks Comment on Disposition of Down Payments and Pending Applications for Licenses Won During Auction No. 35*, FCC 02-248 at 3 (rel. Sept. 12, 2002).

b. The Commission Should Not Place Any Restriction On License Eligibility

The Commission asks whether it should restrict certain parties from applying for licenses in the 71-76 GHz and 81-86 GHz bands to preserve a competitive environment for this new commercial spectrum.[61] Eligibility restrictions may be a useful tool for ensuring that spectrum does not become concentrated in the hands of incumbent monopolists.[62] In the instant case, Loea's proposed licensing framework will allow providers to enter the market at any time. This mechanism should be sufficient to ensure competition in this band. Open licensing eligibility is therefore in the public interest because it will encourage new entry and investment[63] while bearing little risk of monopolistic abuse.[64]

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61 *NRPM* at ¶ 77.

62 Eligibility restrictions may also be required, explicitly or impliedly, by statute. *See, e.g., Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, CC Docket No. 92-297, Second Report and Order, FCC 97-82, 12 FCC Rcd. 12545, 12636-38 (1997) (finding that there is no statutory prohibition on an incumbent LEC obtaining an LMDS license). Nothing in the Communications Act or related legislation, however, includes such a proviso for the UMW spectrum.

63 Congress's intent in requiring the reallocation and licensing of new radio spectrum holds a clear public interest purpose: "The Commission is required to adopt bidding methodologies that promote rapid deployment of advanced services to all the people of the United States, including those in rural areas; provide opportunities for small businesses, and prevent the selling of licenses for unjust enrichment." *House Report* at 246.

64 The Commission adopted a similarly broad eligibility approach in the *Part 27 Order*, reasoning that "opening the [wireless communications system] market to a wide range of applicants will permit and encourage entrepreneurial efforts to develop new technologies and services." *Part 27 Order*, 12 FCC Rcd. at 10829.

c. Band Managers Should Not Be Only Type Of Licensee Authorized For The UMW Bands

The Commission seeks comment on whether permitting band managers to hold licenses in the 71-76 GHz and 81-86 GHz bands is appropriate.[65] Loea suggests that the answer depends on the manner in which the Commission will seek to utilize the band manager construct. That is, if a UMW applicant under Loea's proposed licensing scheme is able to identify itself as a common carrier, a private carrier, a non-carrier or a band manager for appropriate regulatory purposes treatment, Loea has no objection to the band manager licensee classification.[66]

If, however, a limited number of "band manager licenses" were offered for the UMW spectrum, this rule would be inappropriate for the 71-76 GHz and 81-86 GHz bands. Loea's chief concern is that this reliance on band managers would defeat one of the most compelling characteristics of the UWM spectrum — the ability to accommodate a nearly unlimited number of companies providing service via pencil beam transmissions. In addition, this type of band manager would artificially create scarcity, necessitating a spectrum auction. An auction would dramatically increase costs of entry and, of necessity, would be passed through in higher end-user prices for UMW services. As such, this concept of limited "band manager licenses" creates an unnecessary middleman and, in light of the fact that several interested parties have indicated both the willingness and the ability to undertake their own path coordination,[67] would appear to do nothing more than add costs to an already costly proposition.

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65 *NPRM* at ¶ 80.

66 As an example, and for the sake of clarity, if a provider wished to provide turn-key products and services to its customer who would exercise control over the radio facilities, it would be appropriate to allow the provider to designate itself as a Band Manager in order to avoid potential unlawful transfer of control issues. The Band Manager would of course still be required to coordinate its paths with the path coordinator.

67 *E.g.*, Loea Petition at 19; PCIA Comments at 4. *See also* DMC Stratex Comments at 3.

Loea notes that band managers are useful primarily where: (1) low-frequency spectrum is prone to interference and thus requires mutually exclusive licenses that must be administered by a neutral third party for the greatest number of users and relieve the Commission of that additional administrative burden;[68] and (2) smaller parties seek to access particular spectrum but cannot make the requisite transaction cost investment.[69] The UMW spectrum, however, does not fit any of these scenarios, rendering band managers unnecessary. Moreover, band managers raise significant issues in the marketplace that may hinder, rather than help, new entities enter the market.

Not only are band managers unnecessary, but they can stunt spectrum development. The key attribute of a band manager is that he holds actual title to the license, while the service providers hold only a leasehold interest. This issue is more than a cosmetic marketing concern. It is axiomatic that investors are more likely to give capital to those with fungible assets than those without. As the NextWave case has taught us, spectrum licenses are assets. Under the band manager concept, the spectrum lessees are deprived of these assets, rendering them unattractive to investors. Thus, entities that require funding the most are made less likely to receive it. As a result, development of innovative services will be squelched.

Moreover, the band manager device renders spectrum lessees vulnerable to the cash position of the manager who holds the license. Were the band manager to declare bankruptcy, the spectrum — and the services it carries — would be put at risk. In this financial climate, where industry players once thought invulnerable have entered bankruptcy, this concern is not

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68 *Amendments to Parts 1, 2, 27 and 90 of the Commission's Rules to License Services in the 216-220 MHz, 1390-1395 MHz, 1427-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands*, WT Docket No. 02-8, Report and Order, FCC 02-152 ¶ 40 (rel. May 24, 2002).

69 *Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended*, WT Docket No. 99-87, Report and Order, 15 FCC Rcd. 22709, 22727-28 (2000).

mere conjecture, but is a real possibility. Thus, reliance on band managers may unintentionally result in disruption or halting of services over the UMW spectrum, which cannot lie in the public interest.

In lieu of a band manager, the Commission should permit the industry to create or select a coordinator — an entity without title to the licenses — to process and record the individual transmission paths of licensees. This coordinator would not have any of the rights of a licensee but would provide a valuable function in administering individual path authorizations to prevent nationwide licensees from interfering with each other. In addition, where necessary, this coordinator would have primary authority to address interference concerns and to assist interferers in altering their transmission paths appropriately. In this way, licensees retain the full value and rights of the license, while minimizing both interference and the burden on the Commission's resources.

3. *Services Causing Interference with Operations in Canada or Mexico Should Be Governed According to the More Stringent Applicable Rules*

The Commission seeks comment on how licensees should coordinate with wireless operations in Mexico and Canada in order to prevent interference.[70] Loea notes that the risk of such interference is at this time minimal, because there are no operations in Mexico or Canada using this spectrum. The Commission's short-term approach of applying Part 101 technical restrictions at United States borders is therefore appropriate.[71] In the event that Canada or Mexico later develop operations in the UMW spectrum, the Commission should require that any U.S. licensee causing interference, whether unintentional or deliberate, will be subject to the more stringent technical rules of the respective countries.

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70 *NPRM* at ¶ 82.

71 *See id.*

4. *The Commission Should Grant 10-Year Blanket Licenses with a Substantial Service Renewal Expectancy*

The Commission seeks comment on whether a 10-year license term with a substantial service renewal expectancy is in the public interest for the 71-76 GHz and 81-86 GHz bands.[72] This construct, presently applied to LMDS and other licenses, is appropriate to ensure that licensees utilize this spectrum in the public interest. Loea therefore supports a renewal expectancy upon a showing that the licensee has used its blanket licenses to provide substantial service to the public.[73]

5. *The Commission Should Apply the Construction Requirements in Rule 101.63 to Licensees in the 71-76 GHz and 81-86 GHz Bands*

The Commission asks which, if any, construction requirements it should require licensees to satisfy in order to retain use of the spectrum.[74] Based on its proposal that the Commission grant blanket licenses with individual, coordinated transmission paths, Loea suggests that licensees be given 6 months to construct each path after receiving coordinator approval. Primary enforcement authority for this requirement should vest with the coordinator, as it is the repository of the site path information and will be best suited to monitor compliance. In the event of substantial noncompliance, the coordinator would inform the Commission, which would reserve all authority for imposing fines as well as license suspension and revocation.

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72 *NPRM* at ¶ 83.

73 Substantial service is defined as "service which is sound, favorable, and substantially above a level of mediocre service which might minimally warrant renewal" 47 C.F.R. § 101.1011.

74 *NPRM* at ¶ 86.

6. *Individual Stations Need Only Be Reflected In Coordination Database*

The Commission asks whether, if it grants licenses in the 71-76 GHz and 81-86 GHz bands by geographic regions, individual stations within a particular region may obtain site licenses in this spectrum.[75] As Loea has explained, geographic licenses create artificial spectrum scarcity and are therefore inappropriate for the UMW spectrum. Under the blanket licensing scheme that Loea and the WCA propose, individual site deployments would be reflected in the path coordinator database.

7. *The Commission Should Forbear from Applying the Historical Title II Regulations on Carriers Using the 71-76 GHz and 81-86 GHz Bands*

The Commission seeks comment on whether Section 10 permits forbearance from applying historical Title II regulation to the services to be provided over the spectrum at 71-76 GHz and 81-86 GHz.[76] Section 10 of the Communications Act, as amended, 47 U.S.C. § 160, provides that "the Commission shall forbear from applying any regulation or any provision of the Act to a telecommunications carrier" where the Commission finds that such enforcement is not necessary to ensure just and reasonable terms and conditions of service or to protect consumers, and that forbearance from enforcement is in the public interest.[77] Under this analysis, the Commission held that forbearance on Title II regulations such as interconnection, tariffing,

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75 *NPRM* at ¶ 88.

76 *Id.* at ¶ 89.

77 47 U.S.C. § 160(a). Section 332 of the Act provides similar forbearance authority specific to mobile services, but the Commission historically has relied upon Section 10 in the context of wireless service regulation as "there is no decisionally significant distinction between the substantive standards for forbearance set out in Section 10 and in Section 332(c)(1)(A)." *Forbearance from Applying Provisions of the Communications Act to Wireless Telecommunications Carriers*, WT Docket No. 98-100, FCC 00-311, 15 FCC Rcd. 17414, 17420 (2000).

ratesetting and contract filing will not impede competition or contravene the public interest. In addition, the Commission has forborne from applying Section 203 tariffing requirements for competitive LECs and competitive access providers under its permissive tariffing regime.[78] Finally, because the facilities employed in providing paths in the UMW spectrum have no monopoly characteristics,[79] there is no need to apply Section 201 and 202 regulations. All of these forbearance measures are appropriate in the context of the UMW spectrum, which is of necessity a purely competitive market that will accommodate an almost unlimited number of service providers.

8. Grant of Blanket Nationwide Licenses With Site Path Coordination Renders Partitioning and Disaggregation Unnecessary

The Commission proposes to permit licensees in the 71-76 GHz and 81-86 GHz bands to partition their service areas and disaggregate their spectrum.[80] Under the coordinated blanket nationwide license approach that Loea and others propose, a virtually unlimited number of entities can utilize this spectrum in any market. Further, blanket licensing with path coordination significantly lowers the costs of deployment, alleviating the Commission's concerns that small entities will face insuperable barriers to entry. Thus, partitioning and disaggregation, typically employed as a means to increase the number of spectrum users, would only add an unnecessary layer of administrative complexity.

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78 *Id.*

79 Because it accommodates a virtually limitless number of users, and can be deployed effectively on a path-by-path basis, the UMW spectrum is not a natural monopoly, nor does it entail any economic barriers to entry.

80 *NPRM* at ¶ 91.

V. THE COMMISSION SHOULD ADOPT TECHNICAL RULES FOR THE 71-76 GHz AND 81-86 GHz BANDS THAT COMPLEMENT THE UNIQUE CHARACTERISTICS OF THIS SPECTRUM

The Commission's proposed technical rules reflect its conventional approach to spectrum management. This approach, while sound in the context of lower-frequency spectrum, does not comport with the propagation characteristics of the spectrum at 71 and 81 GHz. Thus, while application of the more flexible Part 101 rules is appropriate, enforcing the co-channel and adjacent band interference rule in Section 101.105 is not. Because, as the Commission tentatively concludes, spectrum channelization should not occur in these bands, Rule 101.105 does not provide the proper technical parameters for this spectrum. Loea therefore proposes an alternative band-edge filtering approach, and supports the WCA's proposal on total radiated power and antenna directionality, as a means of minimizing interference without unduly restricting operations. For more detailed explanation of the technical proposals discussed herein, Loea refers the Commission to Section 1 of the attached Lovberg Paper.

A. Part 101 Provides the Appropriate Regulatory Construct for These Bands

The Commission tentatively concludes that Part 101 is the correct regulatory construct for the 71-76 GHz and 81-86 GHz bands.[81] Loea strongly supports this approach, as Part 101 provides the requisite flexibility for entities to achieve maximum use of this spectrum. Further, as the Commission notes, Part 101 also governs Fixed Microwave Services in the 24 GHz band, which employ a point-to-point deployment pattern similar to that contemplated for the UMW spectrum.

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81 *NPRM* at ¶ 93.

B. The Commission Should Adopt Technical Rules That Comport with the Unique Propagation Characteristics of the 71-76 GHz and 81-86 GHz Bands

1. The Commission should not channelize these bands.

Loea strongly urges the Commission to reject channelization of this spectrum.[82] Channelization is an entirely unnecessary measure as a technical matter. As the Commission has noted, channelization is a means of protecting co-primary Federal operations and adjacent operations in lower-frequency bands. Yet it has already been demonstrated that UMW spectrum does not carry a significant risk of such interference. Simply put, there is no technical issue here to solve.

More importantly, channelization would artificially limit the tremendous capabilities of UMW spectrum, particularly its broadband transmission potential, thus discouraging its use. The Commission in fact specifically seeks comment on "whether a channelization plan would impede the flexibility of licensees to provide innovative services in these bands."[83] As Loea and several other commenters have explained,[84] this spectrum is best licensed in its full 5 GHz blocks in order that maximum throughput — up to 10 Gigabits per second[85] — is achievable. Channelization is thus "superfluous and can only serve to reduce the flexibility for growth of new services using the bands."[86] Were entities assured that they could deploy such robust and desirable consumer service, the Commission would see explosive growth in this band. Thus, the

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82 *NPRM* at ¶ 97.

83 *Id.*

84 Loea Petition at 14-17; Boeing Comments at 8-9; PCIA Comments at 2-3; FCWA Comments at 2-3.

85 Boeing Comments at 4-5.

86 Lovberg Paper at 14.

Commission would be helping to create maximum spectrum utilization in the manner Congress envisioned.[87]

Finally, Loea reiterates its assurance that rejecting channelization of this spectrum will not "result in a spectrum grab."[88] Because there need not be any exclusive use of this spectrum, except along very specific pencil-beam paths, there can be no such thing as a spectrum grab, or stockpiling, in these bands. Thus, authorizing users for the full 5 GHz block is not inimical to the Commission's goals of encouraging new entry and full utilization of this spectrum;[89] in fact, it will directly further those goals by enabling service providers to aim for the most robust and valuable technologies to deploy over this spectrum.

2. *The Commission should adopt band-edge filtering to protect adjacent bands.*

The Commission seeks comment on an appropriately flexible set of interference protection criteria to apply to the 71 GHz and 81 GHz bands.[90] Specifically, the Commission asks whether the Rule 101.105 criteria adopted for the 24 GHz band, for which a geographic area licensing scheme was created, should be applied to this spectrum, or whether an alternative approach more commensurate with site-by-site licensing is better suited.[91]

Because geographic area licensing is demonstrably unsuited for the UMW spectrum, the Commission should adopt interference protection rules appropriate for the type of path-by-path authorization that Loea and others advocate. Loea thus supports the WCA's proposal that the

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87 The Commission shall administer the public spectrum in a manner that "efficiently utilizes the spectrum for the benefit of the public." *House Report* at 246.

88 Loea Petition at 14.

89 "We seek comment on whether a channelization plan would enhance competition by allowing multiple licensees to effectively operate in the same area." *NPRM* at ¶ 97.

90 *NPRM* at ¶ 98.

91 *Id.*

Commission apply the band-edge filtering requirement of Rule 101.111(a)(ii) that it presently applies to Fixed Microwave Services[92] and to Digital Electronic Messaging Services[93] operating in the 24 GHz band. In fact, by its plain language this provision applies to "operating frequencies above 15 GHz, in any 1 MHz band."[94]

Rule 101.111(a)(ii) requires that the mean power of emissions must be attenuated by at least 11 decibels but not more than 56 decibels, calculated as follows:

$$\mathbf{A = 11 + 0.4(P - 50) + 10 \log_{10} B}$$

A = Attenuation in decibels below the main output power level
P = Percent removed from the carrier frequency
B = Authorized bandwidth used.

Imposing this attenuation requirement will provide ample protection to bands that are adjacent to 71 GHz and 81 GHz. Again, the risk of interference within and near these bands is minimal, such that the Commission should adopt a more flexible, permissive set of interference rules than those it must apply to low-frequency spectrum licensed by geographic area. The fact that band-edge filtering has successfully been applied to Fixed Microwave and DEMS services in the 24 GHz band demonstrates its effectiveness for high-frequency services. The Commission should therefore adopt the WCA's proposal to adopt Rule 101.111(a)(ii) to ensure interference protection by users of the UMW spectrum.

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92 *Terrestrial Microwave Fixed Radio Services*, WT Docket No. 94-148, Report and Order, FCC 96-51, 61 Fed. Reg. 26670 (May 28, 1996).

93 *Reallocation of Digital Electronic Messaging Service*, ET Docket No. 97-99, Report and Order, FCC 97-95, 62 Fed. Reg. 24576 (May 6, 1997).

94 47 C.F.R. § 101.111(a)(ii).

3. *Frequency tolerance of .03 percent is not appropriate for the UMW spectrum*

The Commission seeks comment on the adoption of a frequency tolerance of .03 percent for both fixed and mobile devices operating in the 71 GHz and 81 GHz bands.[95] As the Commission notes, this guideline governs the spectrum at 31.3-40.0 GHz. In that band, the .03 percent frequency tolerance specifically applies to fixed point-to-point microwave services.[96]

Although Loea initially suggested that frequency tolerance rules were appropriate for UMW spectrum,[97] it now finds after field testing that adoption of these rules will needlessly constrain the operations of service providers. To provide the most robust and reliable transmission services, Loea and others may need to vary the precise frequencies that they use within these bands, depending on the service provided. For example, wireless Ethernet services may be best transmitted at one pair of center frequencies, while OC-48 data may be better transmitted at another pair. Permitting this flexibility will result in the most efficient and innovative uses of the spectrum. Such flexibility will not, however, result in the congestion of particular frequencies, as Loea and others have explained, because any portion of these bands shares the same low-interference propagation characteristics that make UMW spectrum a limitless medium. Loea therefore urges the Commission not to adopt any frequency tolerance rules in keeping with the technologically neutral and flexible approach we propose.

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95 *NPRM* at ¶ 99.

96 47 C.F.R. § 101.107.

97 Loea Petition, Appendix C at 4.

4. *The Commission should adopt WCA's proposed rules for total radiated power and antenna directionality*

The Commission seeks comment on Loea's proposal for an EIRP limit of +55 dBW and a minimum 50 dBi antenna gain with a 0.6 degree beamwidth.[98] As Dr. John Lovberg explains, the UMW spectrum is susceptible to rain attenuation, "necessitating higher transmission power levels to tolerate significant rain events."[99] WCA supports Loea's EIRP and antenna directionality proposals, but suggests footnotes to modify the gain, beamwidth, and radiation suppression tables.[100] WCA explains that it these modifications will allow for lower cost, lower performance alternatives.[101]

Loea finds that the WCA's guidelines strike the appropriate balance between signal strength and equipment flexibility, which will encourage alternative services over the UMW spectrum. Thus, Loea supports the WCA's proposal for regulating radiated power and antenna directionality.

5. *The proposed RF safety rules are sufficient to protect public safety*

The Commission proposes to apply the RF safety requirements in Rules 1.1307(b), 2.1091 and 2.1903 to operations in the 71-76 GHz and 81-86 GHz bands.[102] Loea supports this proposal as a proper means of protecting public health and safety.

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98 *NPRM* at ¶¶ 100-101.

99 Lovberg Paper at 4.

100 WCA Comments at 26-28. The technical components of this table are fully described in the Lovberg Paper, Sections 1.1 to 1.7.

101 WCA Comments at 28.

102 *NPRM* at ¶ 102.

VI. THE COMMISSION SHOULD APPLY PART 101 REGULATIONS TO THE 71 GHZ AND 81 GHZ BANDS BUT SHOULD REJECT PROPOSALS FOR EXCLUSIVE LICENSES AND COMPETITIVE BIDDING

The UMW spectrum can accommodate a virtually limitless number of users in any market, such that dividing licenses according to any geographic denomination creates a needless patchwork-quilt of licensees with no concomitant procompetitive benefit. Rather, nationwide licenses regulated under Part 101 technical rules, and administered on a path-by-path basis by a third-party coordinator, provide the appropriate framework to ensure the orderly, yet flexible, use of this spectrum.

A. Use of the General Licensing Procedures in Part 1, Subpart F of the Rules Is Appropriate

The Commission asks whether it should use Part 1, Subpart F licensing processes for the 71-76 GHz and 81-86 GHz bands.[103] Loea agrees that a normalized, familiar licensing system should be used for this spectrum in order to give finality and predictability to the process. Thus, the Commission should require that initial applications for nationwide UMW licenses comport with these application procedures.

B. Competitive Bidding Is Unnecessary for the 71-76 GHz and 81-86 GHz Bands And May Hinder Service Deployment

The Commission tentatively concludes that competitive bidding is the appropriate mechanism to resolve mutually exclusive applications for the 71-76 GHz and 81-86 GHz spectrum.[104] As Loea and others have explained, however, no mutual exclusivity situations need arise in this spectrum.[105] Transmissions at these frequencies propagate on extremely narrow

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103 *NPRM* at ¶ 103.

104 *Id.* at ¶ 107.

105 Loea Petition at 17; Boeing Comments at 6-7; WCA Comments at 3; Endwave Comments at 3-4.

beams, thus rendering interference nearly impossible. Interference between site paths can be corrected with a path adjustment of only a few degrees, as determined and monitored by the coordinator. Thus, "almost an infinite number of providers" can operate in this spectrum in any given area.[106] The Commission therefore should not anticipate or create situations of mutual exclusivity, and should not subject the UMW spectrum to auctions.

C. The Universal Licensing System Is Appropriate for Recording Initial Nationwide Licenses, Allowing the Coordinator to Retain Individual Site Path Records

The Commission seeks comment on whether it is appropriate to process blanket licenses in the 71-76 GHz and 81-86 GHz bands via the Universal Licensing System ("ULS").[107] As explained in Section IV.B., Loea believes that ULS is the means by which to process and record licenses in these bands. Following grant of the licenses, the third-party coordinator will assign transmission paths for each licensee in order to ensure that services are deployed without risk of interference. These paths will be recorded by the coordinator, subject to Commission inspection, in order to relieve the Commission of that administrative burden. These records will be open for public inspection as would any document related to the administration of spectrum.

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106 Boeing Comments at 7.

107 *NPRM* at ¶ 118.

CONCLUSION

For these reasons, the Commission should take the following actions for the allocation and governance of the 71-76 GHz and 81-86 GHz bands, the UMW spectrum:

- Adoption of the proposed FSS and MSS uplink and downlink consolidation in these bands;
- Deletion of RAS from the 72.77-72.91 GHz band;
- Adoption of technical rules to protect satellite operations in the 74-76 GHz band rather than adoption of a formal footnote. These rules should be in the form of PFD limits of -138 dBW/m^2/MHz at 0° to 5° declination and at 5° to 25° declination at the earth surface;
- Grant co-primary status to Federal operations in the 75.5-76 GHz band in order to create a uniform Federal-commercial co-primary allocation throughout the 71-76 GHz band;
- Grant authorizations for the UMW spectrum in their full 5 GHz blocks;
- Require full authorization for all UMW users;
- Authorize UMW usage on a nationwide basis, rather than by geographic area;
- Permit the maximum licensee eligibility permitted under Section 310 of the Act;
- Establish path coordinators for the nationwide UMW licenses, and not band managers that may hinder service growth;
- Grant 10-year UMW licenses with a renewal expectancy requiring individual transmission path build-out within 6 months of path authorization;
- Forbear from applying historical Title II regulations on UMW users contained in Sections 201, 202, 203, 204, 205, 211 and 212;
- Hold that UMW spectrum shall not be subject to competitive bidding or mutual exclusivity due to the unique propagation characteristics of this spectrum that permits virtually unlimited users in any given market;
- Adopt the WCA's proposed technical rules, which will encourage broad development of equipment and services for the UMW spectrum.

Respectfully submitted,

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SPECIFIC PROPOSALS FOR TECHNICAL RULES GOVERNING THE 71-76, 81-86, AND 92-95 GHZ BANDS

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In preparing its response to the FCC's NPRM regarding Rulemaking in the 71-76, 81-86, and 92-95 GHz Bands, the WCA Over 40 GHz Committee proposed a set of operating standards for FCC consideration in subsequent rulemaking proceedings. In developing this proposal, they attempted to identify a framework that would allow maximum flexibility for the emergence over time of new technologies and services within the subject bands, rather than considering specific applications or hardware embodiments. Each proposed operating standard is discussed in this paper, along with the logic process used to derive it.

SECTION 1. HARDWARE OPERATING STANDARDS

The rules governing fixed-service use of the subject bands must address antenna and transmitter standards, and may address receiver performance standards as well. In this section, we derive a self-consistent set of hardware standards which create an equitable and efficient framework for fixed-service operations in the bands.

1.1 Antenna Directionality

The geographic parceling paradigm is a form of an "exclusive use" spectrum rights model, which can be differentiated against the need for auctions only when the number of geographic paths becomes effectively infinite, and spectrum scarcity disappears. This condition can prevail only by way of rather aggressive limits on the spatial extent of antenna beams, thereby limiting the "exclusion zones" created around transceivers by near-axis and off-axis emissions from the antennas.

In areas with a high density of link deployments in the subject bands ("congested" areas), a convenient and technically appropriate restriction on the angular extent of radiated beams is a one-degree cone. A simple uniformly-illuminated circular dish generating an Airy pattern with its second null on a cone of 1-degree half angle has a half-power beamwidth of 0.46 degrees and a nominal gain of 50 dB. The magnitude of the second sidelobe (the highest radiation level outside of the one-degree cone) is 24 dB below that of the main beam; this can be further suppressed using a tapered aperture function. The minimum gain requirement of 50 dB was adopted by Loea in filing its FCC petition, along with a slightly-relaxed maximum half-power beamwidth restriction of 0.6 degrees (to accommodate slightly non-circular beam profiles characteristic of linearly-polarized feeds, while not accommodating highly non-circular beam profiles that could compromise spectrum reuse). These proposed standards were approved by the WCA Over 40 GHz Committee as generally appropriate for FCC technical rules governing the bands of interest, subject to a waiver described in the following section.

1.1.1 Low-Gain Antenna Variances: Power Tradeoff with Antenna Gain

Certain members of the WCA Over 40 GHz Committee pointed out the usefulness of including in the FCC rules a waiver allowing deployment of antennas of less than 50 dB gain, in trade for reductions in authorized transmit power. Such an allowance, they argued, would provide for lower cost, lower performance solutions for shorter range deployments. In order to guarantee that the existence of such systems will not compromise the integrity of gain-compliant systems, the size of exclusion zones created around transmitters using low-gain antennas would be maintained equal to or smaller than those created by the compliant systems. This condition is ensured by managing the power emitted at angles well away from the main beam, in practice characterized by the antenna front-back power ratio (FBR).

As antennas become smaller, their sidelobes move outward in angle, causing the FBR to increase. For uniformly-illuminated square-aperture antennas, the FBR scales approximately linearly with gain. For uniformly-illuminated circular antennas, the FBR goes approximately with gain to the 3/2 power. The most common antenna type operating above 5 GHz is a circular antenna in which a tapered aperture function is employed to reduce sidelobe levels; for such antennas, the FBR typically scales with gain squared. Comparing antennas from one manufacturer (Andrew) at 6 GHz, the HP4-57W, HP8-57W, and HP12-57W exhibit gain of 35, 41, and 44 dB respectively, with advertised FBRs of 52, 64, and 70 dB. In these cases, the FBR changes by 2 dB per 1 dB of antenna gain.

In order to maintain fixed large-angle exclusion zones around transmitters, then, the maximum authorized transmitter power must drop by 2 dB per dB of gain variance

from the 50 dB minimum gain standard. This trade was adopted by Loea and the WCA and included as a proposed operating standard in the WCA's NPRM response.

1.2 Radiated Power

The propagation characteristics of the subject bands make them robust against many adverse weather conditions, including snow and fog. However, rain attenuates millimeter-wave radiation strongly, necessitating higher transmitter power levels to tolerate significant rain events. In the absence of rain, highly reliable operation of Gigabit communication links has been demonstrated to distances of greater than 10 miles, using only a few milliwatts of transmitter power in conjunction with high-gain antennas. However, strong rain attenuation (over 30 dB per kilometer at a 100 mm/hr rain rate) dictates that higher power is needed to achieve reliable operation over distances as short as one kilometer.

An EIRP limit of +55 dBW, commensurate with the limits of all other fixed service bands above 20 GHz that are regulated under FCC Part 101, is high enough to allow broadband communications transceivers to reach meaningful line-of-sight distances (around 1 mile) at 99.999% rain availability, but not so high as to cause undue interference.

The +55 dBW EIRP limit corresponds to a power level of about 1 Watt for an antenna of 1 meter in diameter. This power level represents a practical limit for spatially-combined solid-state amplifiers in this frequency band, and is about a factor of two below the accepted health safety limit ($4P/A \leq 1$ mW/cm^2), below which environmental exposure evaluations are not required. Even if it were practical to increase transmitter power by a factor of ten relative to this limit, the horizontal range at which a link could

tolerate a heavy rain event would increase by less than 300 meters. For these reasons, the EIRP limit of +55 dBW was suggested by Loea in its FCC petition, and was subsequently deemed appropriate by the WCA Over 40 GHz Committee.

1.3 Receiver Performance, Interference Temperature, and Exclusion Zones

The most practical forms of spectrum use across the subject bands involve modulation schemes which spread information broadly (nearly uniformly) across the available bandwidth, so the concept of "interference temperature" is particularly appropriate for defining the extent of exclusion zones around transmitters. Also appropriate is the concept of placing minimum expectations on receiver performance, where interference protection is assured only to a "reasonable" level of receiver interference susceptibility defined by the interference temperature. The "isotherms" of interference temperature around a transmitter then define exclusion zones for specific classes of receivers.

A condition of mutual non-interference is maintained when desired incoming signals are received at a specified "reasonable" level above a "thermal noise" level, as referred to the interference temperature. Considering the link power budget, including losses due to the atmosphere and weather, a transceiver must receive a minimum power level P_r defined as follows:

$$P_r = P_t \frac{G_t G_r \lambda^2 L_{O_2} L_{H_2O} L_{fog} L_{rain}}{(4\pi)^2 R^2} \geq P_{noise} (T_{int} / T_0)(\text{S/N})(\text{NF}),$$

where typical parameter values are given in the following example.

EXAMPLE

Taking link budget parameters as follows:

P_{noise}	=	-77 dBm	thermal noise power over 5 GHz at ambient temperature,
T_{int}/T_0	=	6 dB	interference temperature relative to ambient temperature (for instance),
S/N	=	14 dB	signal-to-noise ratio required by receiver for error-free link performance (for instance),
NF	=	7 dB	receiver noise figure (for instance),
G_t	=	56 dB	gain of 4-foot dish transmit antenna,
G_r	=	56 dB	gain of 4-foot dish receive antenna,
λ^2	=	-48 dBsqm,	wavelength squared at 73 GHz,
$(4\pi)^{-2}$	=	-22 dB,	numerical constants, and
P_t	=	+29 dBm,	maximum transmit power for a +55 dBW EIRP, leaving

$$\frac{L_{atm} L_{H20} L_{fog} L_{rain}}{R^2} \geq -121\,\mathrm{dB\,m^{-2}}.$$

Over a 1 mile (1.6 km) path, using maximum loss values,

R^{-2}	=	–64 dB m^{-2},	
L_{O2}	=	–0.3 dB	oxygen absorption loss,
L_{H2O}	=	–0.9 dB	water vapor loss at 100% RH at 10°C,
L_{fog}	=	–5.1 dB	supersaturated with additional 1 g/m^3 liquid H_20 at 10°C, leaving a rain loss budget of
L_{rain}	≥	–50.7 dB,	

which corresponds to a tolerable rain rate up to 100 mm/hr across the entire signal path.

When the noise background exceeds the interference temperature threshold, a link operating in weather conditions at the power margin will fail to achieve the signal-to-noise ratio required for error-free operation. In the example above, the ratio of transmitted power to noise power at the interference temperature is 100 dB.

1.4 Antenna Radiation Suppression Requirements

The degree of radiation suppression away from the transmitted beam centerline determines the size of the exclusion zone around a transmitter. In general, the size of this zone is a function also of the pointing angles of the potentially interfering transmitters, relative to the displacement vector between the transmitters (see figure 1).

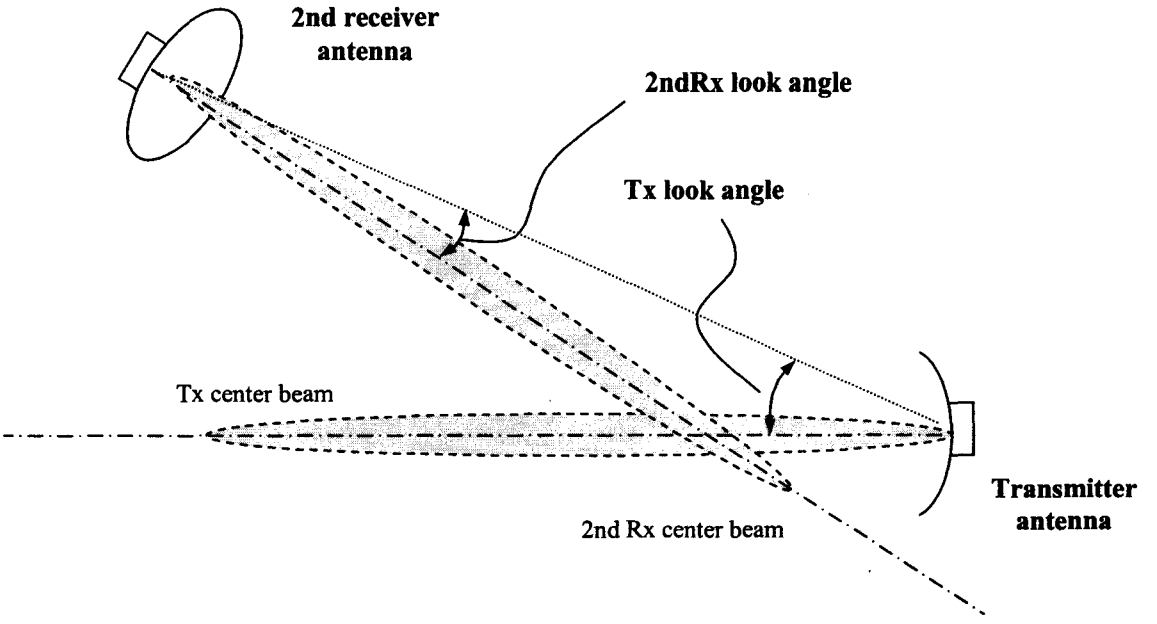

Figure 1. Geometry describing off-axis radiation suppression as related to mutual interference between transmitters.

1.4.1 Suppression at 1 to 5 degrees off centerline

Technical rules for microwave bands covered under Part 101 specify minimum radiation suppression limits beginning at 5 degrees off centerline. However, without spectrum segmentation or issuance of "exclusive use" spectrum rights through auctions on a wide geographic area basis, spectrum scarcity is avoided in the subject bands only when the number of independent operating paths becomes infinite, and achieving this condition demands the implementation of tighter limits on radiation suppression. As stated previously, suppression limits beginning at 1 degree off centerline are more suitable for these bands. Appropriate limits on radiation outside of a cone of 1-degree polar angle are determined by considering the sizes of the exclusion zones created around non-cooperative transmitters pointed at small angles toward one another.

Using operating parameters from the example above, for transmitters operating at maximum power level clear dry weather, two non-cooperative antennas separated by one kilometer and pointed directly at one another would need at least 82 dB of signal isolation to coexist without interference. Translating either link laterally by 17 meters (or each by 8.5 meters in opposite directions) offsets the displacement vector between the non-cooperative antennas by 1 degree relative to the link lines of sight. With 33 dB of radiation suppression at 1 degree from beam centerline for each antenna, plus additional isolation of at least 16 dB from cross-polarizing the signal beams, the requisite isolation is achieved.

As antenna gain is reduced, the small-angle suppression requirement is also alleviated. If the links in the example above are converted to two-foot (50 dB nominal gain), rather than four-foot antennas (at fixed EIRP), the additional radiation suppression required at one kilometer drops from 82 dB to 76 dB, lowering the suppression requirement for each antenna by 3 dB, or one-half dB for each dB of reduced antenna gain.

For antenna gain below 50 dB, the separately proposed reduction in authorized power (by 2 dB per dB of reduced antenna gain) further alleviates the suppression requirement (by the same factor). A somewhat lower trade factor of 12/7 dB per dB of antenna gain is proposed to account for the fact that the position of the first sidelobe, which represents the angle of minimum radiation suppression, moves outward from the one degree cone as the gain drops.

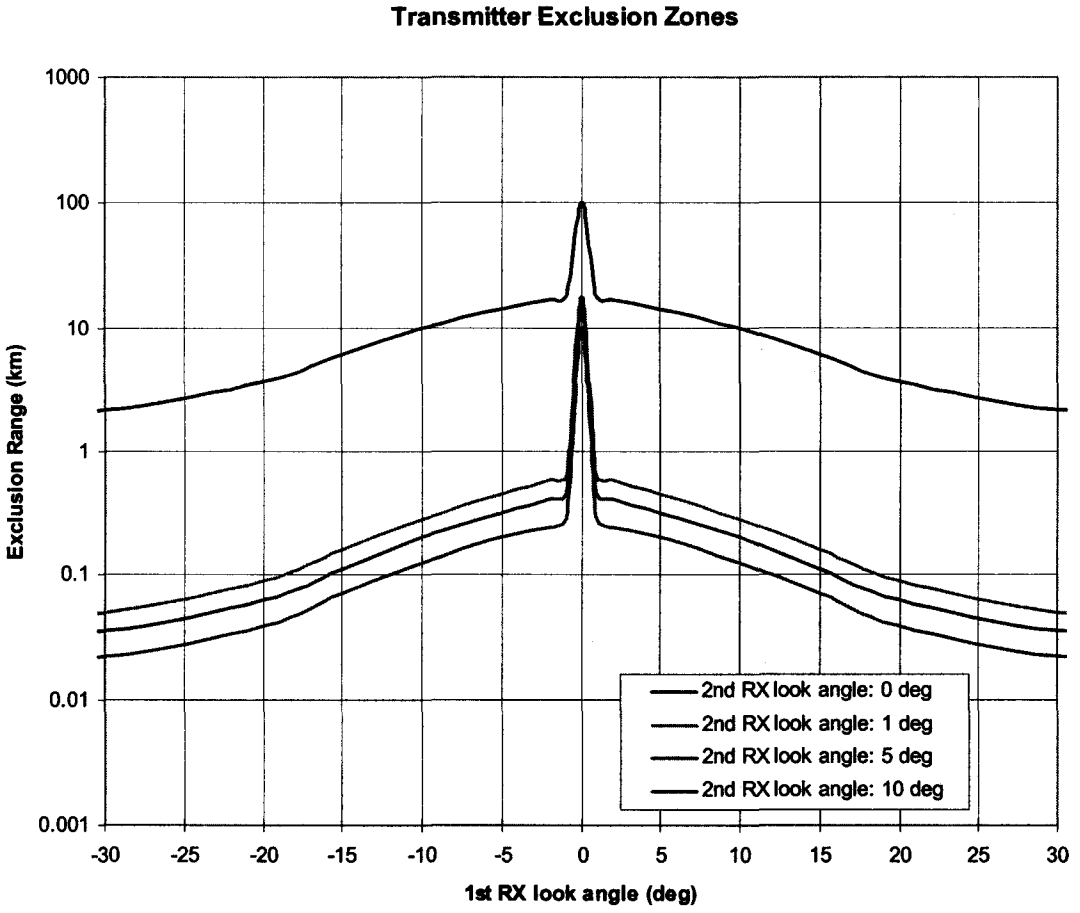

Figure 2. Clear weather exclusion zone envelopes for the transmitter described in the example above, assuming 33 dB sidelobe suppression at 1 to 5 degrees, 36 dB at 5 to 10 degrees, 40 dB at 10 to 15 degrees, 45 dB at 15 to 20 degrees, 50 dB at 20 to 30 degrees, and 55 dB beyond 30 degrees off centerline. Note: Additional isolation of 20 dB from cross-polarized transmitters is assumed.

Although the proposed antenna gain regulations allow a variance for antennas below 50 dB, the suppression requirement at 1 degree places a hard lower limit on antenna gain of about 43 dB (roughly a 25-cm dish), since at lower gain the main beam itself extends out to beyond 1 degree.

1.4.2 Suppression at 5 to 10 degrees off centerline

The isolation required between non-cooperative transmitters (using four-foot antennas) increases from 82 dB at one kilometer spacing to 96 dB at 200 meter spacing. At the shorter spacing, translation of either link by 17 meters results in a 5 degree offset between the displacement vector and the lines of sight. With 36 dB of radiation suppression at 5 degrees from beam centerline, and the addition of 24 dB of cross-polarization isolation at this angle, the links can coexist without interference.

1.4.3 Backlobe Suppression

Again using operating parameters from the example above, when a second transmitter is placed on a rooftop at a distance of 5 meters from an existing transmitter, antenna isolation of 128 dB is required to avoid mutual interference. In general, a judicious mounting location can be chosen such that the transmitter beam directions are at least 90 degrees away from the displacement vector between the transmitters. With 55 dB of radiation suppression for angles pointing backward from the antenna planes, even at these larger angles, cross-polarization can provide the final 18 dB of isolation as required for non-interference.

If a large number of antennas are to be placed on a single rooftop in a spoke-hub geometry, backlobe suppression of 65 to 70 dB can eliminate the need for cross-polarizing transmitters. Radiation suppression of this magnitude is often more difficult to measure (for certification purposes) than it is to achieve in practice. In most cases where such an architecture is deployed, a single manufacturer's equipment will be utilized, and the onus of attaining the requisite backlobe suppression will fall to that equipment manufacturer.

1.4.4 Power Tradeoff with Beam-Boundary Radiation Suppression

The small-angle suppression requirements derived above are significantly higher than are typically achieved at lower frequencies, but they should be achievable at high frequency. For an ideal four-foot antenna operating at 73 GHz, the highest radiation level outside of the one-degree cone corresponds to the fifth sidelobe of the Airy pattern, 34 dB below the main beam magnitude even for uniform aperture illumination, and thus meeting the small-angle requirement. On the other hand, the absence of hardware currently meeting these requirements in large scale production is a significant source of concern for many equipment manufacturers, including several members of the WCA's Over 40 GHz Committee.

If the radiation suppression requirements designated in these examples cannot be achieved for transmitters operating at maximum authorized power levels, the result will be an excessive interference temperature at the location of a non-cooperative transceiver. Assuming that the antennas for two non-cooperative links fail to meet requirements by similar margins (causing both transmitter performance and receiver interference susceptibility to fall short of expectations in each link), then maximum authorized transmitter power levels must be reduced by 2 dB per dB of antenna suppression variance in order for the links to continue to operate without interference. A waiver to the suppression requirements allowing the deployment of lower performance antennas at a penalty in authorized power is proposed as a practical way to accommodate immediate technology deployment without compromising the potential for future technology improvement.

1.5 Antenna Polarization

The extent of the exclusion zones created around transmitters, as discussed in the previous section, is mitigated by considering the added isolation afforded by cross-polarizing non-cooperative transceivers which might otherwise interfere. Mandating linear antenna polarization for fixed services provides a buildout coordinator an important tool for coordinating links in an environment of dense link deployments. Circularly polarized transmitters used side-by-side with linearly polarized transmitters cannot afford this isolation. Future mobile and satellite deployments will make use of circularly polarized beams, since the orientations of moving transmitters will change with time. For these reasons, Loea suggested that linear antenna polarization should be mandated for fixed services in the subject bands. After review by the WCA, this suggestion was adopted as a proposed operating standard.

1.6 Adaptive Transmitter Power Control

Intuitively it seems obvious that the use of Adaptive Transmitter Power Control (ATPC) should be a highly effective way of reducing off-axis radiation suppression requirements on antennas. However, in rain conditions at the operational margin (100 mm/hr), the link in the example above would necessarily operate at full transmitter power even with ATPC. An equivalent non-cooperative link 200 meters away would similarly operate at full power, but due to the relatively short path between the non-cooperating transmitters, rain attenuation along this path will be insignificant (providing only about 6 dB of the required 96 dB of isolation). Thus the off-axis suppression requirements remain high, even with ATPC.

On-axis exclusion zones *will* be managed best using ATPC. Using the example link again, the on-axis exclusion zone in clear, dry weather reaches 100 km. For highly reliable operation in all weather, however, (*e.g.*, for 99.999% link availability in New York City), the useful operating range of the link is only 1.6 km. If a 1.6 km link were designed to operate at full power at all times, the entire 100 km "pipe" is wasted as a clear-weather exclusion zone (in practice, line-of-sight restrictions including buildings, trees, terrain, and even earth curvature, cut this length down considerably, as it applies only for non-cooperative transmitters pointing directly back to the subject transmitter along a clear line of sight). Using ATPC to maintain the transmitter power at a much lower, safe signal-to-noise ratio (say 20 dB) at the receiver, this exclusion zone shrinks to less than 3.5 km.

The issue of mandating ATPC by FCC rule was discussed at length by the WCA Over 40 GHz Committee. The consensus of the Committee was that ATPC would be adopted by necessity by equipment manufacturers, since the receiver dynamic range required for operation without ATPC (57 dB in the example above) is impractical to achieve. Simply put, without ATPC, links designed to survive "five nines" weather conditions would experience receiver saturation and even front-end burnout in clear weather.

1.7 Summary of Antenna Operating Standards

Finally, then, a set of antenna operating standards proposed for consideration by the FCC is presented, with footnotes, in the tabular format used in FCC Part 101.115(c). The proposal to mandate linear antenna polarization is stated separately.

Frequency (MHz)	Cat	Maximum beamwidth to 3 dB points (included angle in degrees)	Minimum antenna gain (dBi)		Minimum radiation suppression to angle in deg from centerline of main beam in decibels						
					5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000	A	0.60†	50‡	*L_1	36	40	45	50	55	55	55
	B	0.60†	50‡		33	36	39	42	45	45	45
81,000 to 86,000	A	0.60†	50‡	*L_1	36	40	45	50	55	55	55
	B	0.60†	50‡		33	36	39	42	45	45	45

† For antenna gain < 50 dBi, maximum authorized beamwidth in degrees increases to $0.60 * 10^{(50-G)/20}$, subject also to added constraints on power described below.

‡ Antenna gain less than 50 dBi is permitted with a proportional reduction in maximum authorized transmitter power in a ratio of 2 dB of power per 1 dB of gain, so that the maximum allowable EIRP (in dBW) for antennas of less than 50 dBi gain becomes +55 – 3 (50 – G), where G is the antenna gain in dBi.

***For the bands 71-76 GHz and 81-86 GHz, in zones of frequency congestion, the following specification is included for minimum radiation suppression L_1 at angles from 1° to 5° from centerline of main beam in dB: 30 + (1 / 2) (G – 50) ; G ≥ 50 dBi ; 30 + (12 / 7) (G – 50); G < 50 dBi. The Commission recognizes that high levels of radiation suppression are difficult to achieve so close to the main beam, and agrees to allow a variance from this standard in return for a proportional reduction in transmitter power, in a ratio of 2 dB per dB of suppression variance: EIRP = +55 – 2 (L_1 - L). This power reduction is in addition to any reduction that may apply independently for antennas with gain of less than 50 dBi.**

SECTION 2. BAND PLANS

2.1 Channel Bandwidth and Modulation Efficiency

The strict rules limiting the spatial extent and authorized transmit power proposed in Section 1 constitute the basis for spectrum sharing in the subject bands. Further restriction on spectrum usage is superfluous and can only serve to reduce the flexibility for growth of new services using the bands. Loea and the WCA agree that the public interest is best served by opening up the entire band as a single contiguous channel, without restrictions on transmit center frequencies or modulation efficiency.

2.2 Interference Protection Criteria

In an unsegmented band, the concept of adjacent channel interference is not pertinent, and co-channel interference is addressed by managing the size and orientation of antenna beams. More relevant is the issue of interference with services in adjacent bands, for which Section 101.111(2)(ii) of the FCC Rules establishes precedence governing interference protection in other bands. This Section provides standards for band-edge filtering; specifically, that in any 1 MHz band, the frequency being removed from the assigned center frequency by a percentage P of more than 50 percent up to and including 250 percent of the authorized bandwidth B, the minimum radiation suppression A, in dB, is less than $A = 11+0.4(P-50)+10 \log_{10}B$, or $A = 56$, whichever is smaller. Loea proposes that spurious power suppression at these limits provides sufficient interference protection for all fixed, mobile, and radiolocation services in the adjoining bands, and that with the additional zonal protection for radio astronomy facilities as proposed in the NPRM, these limits afford sufficient protection for RAS as well.

2.3 Mobile, Satellite, and Radioastronomy Standards

No technology in use today employs the 71-76 GHz or 81-86 GHz bands for mobile or satellite use, and use of these bands in radio astronomy is extremely limited. Fixed-service transceivers have demonstrated for the past two years the ability to provide reliable gigabit-speed data communications over free space at distances of one to ten miles. A significant aim of the current rulemaking proposal is to create the maximum potential for fixed-service users in the band today, while minimally impacting the future potential of the band for enabling new satellite, mobile, and radio astronomy services.

While the free-space propagation characteristics of the upper MMW bands are highly desirable for fixed, point-to-point communications applications, they come with the requirement for clear line-of-sight propagation paths. The preponderance of obstacles occluding line-of-sight paths near the ground precludes the general applicability of these frequencies to sending or sensing information near the ground, except in the special case of carefully surveyed fixed point-to-point configurations.

Exceptions to this rule are encountered in extremely flat terrain such as the ocean surface, and for elevated paths such as those between aircraft at altitude. However, for terrestrial horizontal-path applications, mobile uses will be restricted in general to short paths. The 57-64 GHz frequency band, which has been assigned license-free status under Part 15 of the FCC rules, is ideal for these uses, so the exclusion of mobile horizontal-path emissions at 71-76 and 81-86 GHz is not unduly limiting, except in the cases of ship-to-ship and air-to-air applications. Loea proposes such an exclusion, with exceptions for offshore and air-to-air application. These exceptions will provide for future Naval Battle Group Communications and offshore Command, Control, Communications and Intelligence (C^3I) networks, as well as for air-to-air cross-links for Army Future Combat Systems (FCS) Communications.

The limitations of horizontal lines of sight near the ground do not extend to highly-inclined paths. Paths inclined more than 25 degrees from horizontal create sightlines for future air-to-ground and satellite applications. In order to protect these sightlines from interference from fixed-service users, Loea proposes a corresponding restriction on fixed-service installations to inclination/declination angles below 25 degrees absolute.

Atmospheric absorption in weather severely limits the usefulness of mobile satellite operations at lower declination paths, so constraining satellite operations to highly-inclined paths is again not unduly restrictive. Typically, restrictions on satellite emissions are specified in terms of Power Flux Densities (PFD) at the earth's surface. A PFD limit of -138 dBW/m^2/MHz at a path declination of less than 25° creates an interference temperature of 6 dB above ambient, for a fixed-service receiver pointing directly at the satellite with a 1 m^2 antenna. Loea proposes this PFD limit for satellites at low declination, with no restrictions on satellites at higher declination in this proceeding.

2.4 Federal Use of the 75.5 – 76 GHz Band

The FCC NPRM proposes the conversion of the 75.5 – 76 GHz band from an amateur band to a non-Federal fixed-services band, without specifying Federal co-primary status in this band. This situation presents a complication for hardware suppliers developing "dual use" technology suitable for commercial users as well as Government and Military users. Loea proposes that the new allocation be assigned a co-primary status between Federal and non-Federal uses, to eliminate this potential complication.

SECTION 3. BAND COORDINATION

Loea has proposed a site licensing scheme in which the responsibility for coordinating technology buildout will fall to a "third party" coordinator. Authorization to install equipment will be given based upon "first to file" priority, assuming that no mutual interference is predicted to result from the installation.

3.1 Site Surveys using GPS with WAAS, Laser Rangefinding, 3-D Mapping

Again, to avoid the need for auctioning "exclusive use" spectrum rights on a wide geographic area basis, the number of independent operating paths must become effectively infinite, which in turn means the position and extent of every active antenna beam must be accurately logged for coordination purposes. The narrow beam size mandated by this proposal affords path discrimination in elevation as well as azimuth and position. It is possible, and even likely, that two or more links will be established between a single pair of buildings, using free-space paths terminating on different floors as well as on different ends of each building.

In order to predict interference along such paths, accurate knowledge of the endpoint coordinates is needed, both in terms of latitude-longitude projection, and in height above ground level (AGL). Endpoint locations can be determined to the required accuracy using GPS with a Wide Area Augmentation System (WAAS), which claims a 95% probability of horizontal error of less than 3.2 meters and vertical error of less than 6.0 meters, along with laser rangefinding to increase accuracy of height AGL to better than 1 meter. Also, in congested areas, exclusion zones are more commonly limited by obstructions (buildings, trees, or terrain) rather than by free-space attenuation, so the coordinator must have access to accurate 3-dimensional maps of these areas. Such maps are currently available for virtually all metro areas, and the coordinator will roll the cost of acquiring and maintaining them into his cost of service. Loea expects that the endpoint measurement equipment and method will be mandated by the coordinator rather than by the FCC.

CERTIFICATE OF SERVICE

I, Stephanie A. Joyce, certify that on this 18th day of December, 2002, a true and correct copy of the foregoing Comments of Loea Communications Corporation, Inc. were served First Class Mail* or electronic mail on the following persons:

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